

GOVERNMENT OF INDIA  
MINISTRY OF RAILWAYS  
(RAILWAY BOARD)

INDIAN RAILWAY  
STANDARD SPECIFICATION  
FOR PRETENSIONED PRESTRESSED CONCRETE SLEEPERS  
FOR TURNOUTS  
BROAD GAUGE AND METRE GAUGE

SERIAL NO. T-45  
(FOURTH REVISION – MARCH 2021)

RESEARCH DESIGNS AND STANDARDS ORGANISATION  
LUCKNOW – 226011

## C O N T E N T S

| <b><u>Para No.</u></b> | <b><u>Description</u></b>                                       |
|------------------------|---|
| <b>1.</b>              | <b>SCOPE</b>  |
| <b>2.</b>              | <b>GENERAL</b>  |
| <b>3.</b>              | <b>MATERIALS</b>  |
| 3.1                    | High tensile steel  |
| 3.2                    | Cement  |
| 3.3                    | Admixture   |
| 3.4                    | Aggregates  |
| 3.5                    | Water   |
| 3.6                    | Concrete  |
| 3.7                    | SGCI Inserts  |
| <b>4.</b>              | <b>MANUFACTURE</b>  |
| 4.1                    | Moulds  |
| 4.2                    | Stretching of wires   |
| 4.3                    | Mixing and Consolidation of Concrete                            |
| 4.4                    | Detensioning of wires   |
| 4.5                    | Curing  |
| 4.6                    | Supervision   |
| 4.7                    | Finish  |
| 4.8                    | Stacking  |
| 4.9                    | Lot   |
| <b>5.</b>              | <b>INSPECTION AND TESTING</b>                                   |
| 5.1.1                  | General   |
| 5.3                    | Checks and Tests  |
| 5.3.1                  | Visual and dimensional check                                    |
| 5.3.2                  | Casting of cubes  |
| 5.3.3                  | Method of testing   |
| 5.3.4                  | Compressive strength of cube at transfer (release) of prestress |
| 5.3.5                  | Test for 15 days compressive strength of concrete               |

|          |   |
|----------|---|
| 5.3.6    | Test for 15 days modulus of rupture of concrete |
| 5.3.7    | Tests for Static bending strength of sleepers   |
| 5.3.7.1  | Method of testing                               |
| 5.3.7.2  | Acceptance tests                                |
| 5.3.7.3  | Acceptance of lots                              |
| 5.3.7.4  | Retest  |
| 5.3.8    | Measurement of Electrical resistance            |
| 5.4      | Competency certificate                          |
| <b>6</b> | <b>STAMPING AND MARKING</b>                     |
| <b>7</b> | <b>LOADING AND DISPATCH</b>                     |
| <b>8</b> | <b>GUARANTEE</b>                                |

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0.        **FOREWORD**

- 0.1        This standard specification was adopted by the Indian Railways in January 1988. The last revision (Third Revision) was adopted by the Indian Railways in November-2016.
- 0.2        The present revision (Fourth Revision) has been taken up with a view to incorporate modifications found necessary as a result of use of the specification both by the manufacturer and user.
- 0.3        The significant modifications incorporated in this revision are as follows:-
- 0.3.1      All Correction slips /Corrigendum (Corrigendum no. 1 to 4) issued till date have been incorporated.
- 0.3.2      List of specifications (IS/IRS codes) needed for daily use and referred to in this specification has been updated in Annexure-VI.
- 0.3.3      Scale of dimensional check for assembled Turnout sets has been modified.

1.        **SCOPE**

- 1.1        This specification covers the manufacture and supply of pretensioned type prestressed concrete sleepers for broad gauge and metre gauge turnouts.
- 1.2        For the purpose of this specifications, a 'set' of sleepers in a turnout shall comprise of sleepers in actual turnout, approach and exit sleepers at the three ends of the turnout and any other special sleepers required.

2. **GENERAL**

2.1 The manufacture of sleepers shall be to the Purchaser's drawing or to the drawings approved by the Purchaser and the production shall commence with the prior approval of the Inspecting Officer. Any subsequent change in material or production technique shall require prior approval of Inspecting Officer.

2.2 The reference to IRS specifications and drawings in this specification relates to the latest version of these standards as amended from time to time. The provisions of this specification shall override the corresponding provisions of IS: Specifications. The list of IRS specifications/ IS codes required for manufacturing of sleepers are given in Annexure- VI.

3. **MATERIALS**

3.1 **High Tensile Steel**

3.1.1 High tensile steel in the form of plain wire or strand shall conform to IS:1785-Part-I and IS:6006. It shall be procured only from BIS approved manufacturers who shall furnish the proof of approval by BIS with the first consignment during the currency of approval and for each fresh approval. Each consignment of high tensile steel must be accompanied by a test certificate showing the serial no. of coils. Each coil shall carry a tag in accordance with the IS specifications mentioned above. In addition to the normal tests stipulated in the IS specifications for every consignment, results of "relaxation test" shall also be furnished once in six months. In case of change of source the first test certificate shall include "relaxation test" results also.

The steel shall be used for production only after ascertaining that it meets the provisions of relevant specifications.

3.1.2 Whenever directed by the Inspecting Officer, the manufacturer shall get the steel in stock tested at the latter's cost.

3.2 **Cement**

3.2.1 Cement shall be OPC 53-S conforming to IS:269 (as amended upto date). However, upper limit of SO<sub>3</sub> and C<sub>3</sub>A content in 53-S grade cement is revised as 3.3% & 9.0% respectively for improvement in quality of PSC sleepers on IR. Upper limit of initial setting time (IST) of 53-S grade cement is specified as 120 minutes preferably but not more than 150 minutes.

- 3.2.2 Each consignment of cement shall be covered by a test certificate. Each consignment shall be stocked separately, tested in the laboratory of the plant immediately for all relevant properties and shall be clearly identified. Cement more than 3 months old, if free from lumps, shall be tested for physical properties by an independent government approved laboratory or as directed by the Inspecting Officer and may be used after his approval.
- 3.2.2.1 The Inspecting Officer has the right to have the cement in stock tested at any time at the cost of manufacturer.
- 3.2.2.2 In case the source of supply of cement is changed, the mix design shall be reviewed and modified, if necessary, as per instructions given in para 3.6.3.1.
- 3.2.3 The cement content of the mix shall not be less than 350 kg/cu. m. and not more than 450 kg/cum.
- 3.3 **Admixture**
- 3.3.1 Super Plasticizer conforming to IS: 9103 may be used with the prior approval of RDSO. At this stage the revised concrete mix design shall also be submitted to RDSO for approval. However, following shall be observed:
- 3.3.2 Use of any admixture containing chloride in any form is prohibited.
- 3.3.3 Generally one admixture at a time should be used.
- 3.3.4 The admixture should be stored as per specified conditions by its manufacturer and its shelf life should be monitored continuously. Regular testing of admixture shall be done annually from NABL approved laboratory/NCCBM/IITs/NITs.
- 3.3.5 All containers should be correctly labeled. Reliable liquid dispenser for liquid admixtures should be used and calibrated.
- 3.3.6 The admixture containing Cl and SO<sub>3</sub> ions shall not be used. Admixtures containing nitrates shall also not be used. Admixtures based on thiocyanate shall be prohibited.

### 3.4 **Aggregates**

- 3.4.1 The aggregates shall conform to IS: 383 and shall, before use, be got tested through an approved testing institute, and results submitted in accordance with Annexure B of IS: 383 to the Inspecting Officer for approval. These tests shall be got done at the manufacturer's cost once in a year or at the time of approval/review of mix design or as desired by inspecting official. The aggregates shall have maximum 30% abrasion and maximum 30% impact value suitable for wearing surfaces when tested in accordance with IS:2386 (Part-IV). Flakiness and elongation shall be determined in accordance with IS 2386 (Part-I) on the same sample. The combined flakiness and elongation index so obtained shall not exceed 40% when tested in accordance with IS:2386 (Part-1).
- 3.4.2 Coarse and fine aggregates shall pass sodium or magnesium sulphate accelerated soundness test specified in IS: 2386 (Part-V).
- 3.4.3 Aggregates shall not contain any harmful material, such as pyrites, coal, lignite, mica, shale or similar laminated material, clay, alkali, free lime, soft fragments, sea shells and organic impurities in such quantity as to affect the strength or durability of concrete. Aggregate to be used for reinforced concrete shall not contain any material liable to attack the steel reinforcement. Maximum limit of deleterious material in aggregates should conform to IS: 383 when tested in accordance with IS: 2386 (Part-II).
- 3.4.4 Aggregate which are reactive with alkalies of cement are harmful as cracking of concrete may take place. Potential reactiveness of aggregates shall be tested as per IS: 2386 (Part-VII).
- 3.4.5 Course aggregates shall be crushed stone, angular in shape and gravel shall not be used.
- 3.4.6 Different sizes of aggregates shall be stacked in different storage bins or stock piles on proper hard floor surface. The bins near batching plant must be located under a covered shed to avoid any chance of raw material getting wet due to rains. Alternatively, auto sensors may be used to record the moisture content in the aggregate along with auto mechanism for adjusting water to be added to concrete in the weigh batcher.

- 3.4.7 If Crushed stone sand is being used as fine aggregates then bond strength (pull out test) of concrete shall be tested as per IS:2770(Part-I) during mix design approval and after production of every 50 sets of turnout sleepers whichever is applicable during regular production. Crushed stone sand being used should not be by-product of any other manufacturing process.

### 3.5 **Water**

- 3.5.1 Water to be used in making and for curing concrete shall conform to IS: 456. However use of sea water is prohibited.

- 3.5.2 If water needs any treatment before use, adequate storage of treated water for daily requirement shall be made. Facilities for testing treated water shall be provided in the plant. Treated water shall be tested daily or as directed by the Inspecting Officer.

- 3.5.3 The total water content per batch shall be regulated with conform with the ratio by weight of free water to cement required for the particular design mix as established by preliminary tests. The total water content of a batch includes:

- (a) Absorbed water in the aggregates;
- (b) Free water in the aggregates; and
- (c) Free water added to the mix.

- 3.5.3.1 The water to be mixed at the mixer shall be free water content required per batch less the amount of free water in the aggregates, if wet, or plus the amount of water the aggregates will absorb, if dry. Free moisture content shall be determined at least once a day.

### 3.6 **Concrete**

- 3.6.1 The concrete shall be of controlled quality with the nominal maximum size of aggregates limited to 20mm. Where wire spacing permits, aggregates upto 25mm may be used. The manufacturer shall get the concrete mix design along with the upper and lower limits of granulometric curves approved by the Inspecting Officer.

- 3.6.1.1 The granulometric curves shall be plotted on semilog graph sheet once in a week and shall be between the approved limits.

- 3.6.1.2 Coarse and fine aggregates shall be batched separately.



3.6.2 The concrete shall satisfy the following design parameters:

- |      |  |                    |
|------|--|--------------------|
| i)   | Minimum release strength after steam curing  | 50 N/sq.mm         |
| ii)  | 15 days characteristic strength after water curing   | 60 N/sq.mm         |
| iii) | Percentage of cubes with strength less than the characteristic strength as per mix design/statistical analysis | Not more than 2.5% |
| iv)  | Co-efficient of variation  | Less than 7%       |

3.6.3 Concrete mix shall be designed as per guidelines in IS:10262 and complying design parameters as per para 3.6.2 by the sleeper plant, checked by zonal railways and got approved from RDSO before start of the sleeper production. RDSO will check and verify the new mix design at the sleeper plant by testing of trial cubes as per para 3.6.4 and complying design parameters as per para 3.6.2.

3.6.3.1 Zonal railways shall review the concrete mix design themselves whenever the source of cement or water or admixture is changed as per guidelines in IS: 10262 provided the quantity of cement is not reduced. All new ingredients must be got tested before hand from reputed laboratory to ascertain whether they are suitable to be used as per relevant standards/ specifications. The copy of test report of all ingredients, mix design calculations, record of trial cube testing and records of modification should be communicated to RDSO for information and should be available with zonal railway as well as with CSP, so that the same can be inspected during oversight inspection by RDSO official. However, if the source of aggregate changes, RDSO should be approached by the zonal railways for approval of the source and also for reviewing/revising the mix design.

Zonal Railway or RDSO will check and verify the revised mix design at the sleeper plant by testing of trial cubes as per para 3.6.4 and complying design parameters as per para 3.6.2.

3.6.3.2 Workability of new/revised mix should be kept low i.e. compacting factor in range of 0.75 – 0.80 for stress-bench method.

3.6.4 At the time of approval/review of mix design, 80 cubes shall be cast, using materials proposed for regular manufacture, in 10 separate concrete batches of 8 cubes each, 4 for steam curing and 4 for water curing.

3.6.4.1 All the 40 cubes cured according to the proposed steam curing cycle shall attain the specified minimum release strength.

3.6.4.2 The statistical analysis of the compressive strength values of the 40 water cured cubes shall satisfy the design parameters of clause 3.6.2 (ii), (iii) & (iv).

### 3.7 **SGCI Inserts**

3.7.1 SGCI inserts shall conform to IRS Specification No.T-46 as amended up-to-date and will be procured only from RDSO approved manufacturers. Each consignment of SGCI inserts shall be accompanied by a test certificate from inspecting agency for inspection conducted prior to dispatch of consignment from supplier's premises.

3.7.2 Whenever directed by the inspecting official, the sleeper manufacturer shall get the SGCI inserts in stock tested at his own cost.

## 4. **MANUFACTURE**

### 4.1 **Moulds**

4.1.1 Moulds, if made up of steel plates shall be of minimum 8 mm thickness with minimum plate thickness of 10 mm in rail seat area as well as for end plates. Moulds can be made using channel section of thickness 6 to 8 mm and end plates of 10mm thickness.

Moulds shall be of rigid construction with adequate number of stiffeners at required locations so as to prevent any distortions during casting of sleepers. Moulds shall not allow any appreciable leakage of cement mortar in casting. The holes in the end plates shall be accurately drilled for correct placement of prestressing wires.

### 4.2 **Stretching of wires**

4.2.1 The prestressing wire shall be stretched either individually or collectively by an approved method. The tensioning force shall be as shown on the sleeper drawing. The final force to be adopted, duly considering the losses while stretching shall be

approved by the Inspecting Officer. However, the stretching force shall in no case exceed 75% of the minimum specified UTS of the wire. The pretensioning force in the wire shall be applied by a tensioning device equipped with automatic load cut off unit along with measuring gauge. The final force shall also be verified by measuring the extension of the wire.

#### 4.3 **Mixing and consolidation of concrete**

4.3.1 Manufacture of sleepers shall be done under a shed.

4.3.2 Batching of different ingredients shall be done by weight only. A modern, mechanized or automatic weigh batcher shall be used for weighing aggregates and cement. The weigh batcher shall have an accuracy of  $\pm 3\%$  for aggregate, admixtures & water and  $\pm 2\%$  for cement.

4.3.3 Modern high speed mixer, pan, turbine or any other suitable type, approved by the Inspecting Officer shall be used for mixing concrete. Concreting shall commence within 2 hours of stressing of wires, failing which the HTS wires shall be checked and retensioned, if necessary.

4.3.4 Concrete shall be thoroughly mixed and consolidated by means of vibrators of at least 9000  $\pm 4\%$  revolutions/minute. The vibrator should normally be fixed at the bottom of the mould with adequate number of vibrators depending upon length of sleeper to provide sufficient vibration for entire length of sleeper. Any other vibration system should have prior approval of RDSO.

4.3.5 Freshly cast sleepers shall be protected during the first stage of hardening from adverse weather conditions.

#### 4.4 **De-tensioning of wires**

4.4.1 Anchoring system shall provide a device for gradual detensioning of the wires. Back pulling of wires for releasing any wedge shall be strictly prohibited. De-tensioning of wires shall be undertaken only after the concrete has attained a compressive strength of 50 N/sq.mm.

#### 4.5 **Curing**

4.5.1 Initial curing of concrete sleeper shall be done by steam at atmospheric pressure till the concrete attains a compressive strength of 50 N/sq.mm. Pre-steaming period shall not be less than the initial setting time of cement.

Total steam curing cycle duration for turnout sleepers can vary approximately from 10 to 12 hours depending on time taken in the steam curing stages e.g. presteaming, temperature rising (heating), constant temperature duration, cooling etc. Total cycle time depends on ambient temperature.

- i) Normal pre-steaming period is recommended as 2 hours or initial setting time (IST) of cement whichever is greater.
- ii) Temperature rising time is recommended as 2.0 to 2.5 hours keeping maximum rate of rise of temperature as 15°C per hour.
- iii) Maximum steam curing temperature shall be not more than 60°C keeping constant temperature in range of 55 – 60°C. Constant temperature duration can be kept between 3.5 to 5.0 hours.
- iv) Cooling of sleepers shall be gradual and cooling period is recommended in range of 2 to 3 hours with cooling rate not exceeding 15°C per hour.

Extra one hour cooling of sleepers after taking out from steam curing chamber at ambient temperature before demoulding is desirable/recommended to minimize the difference in external and internal (inside) temperature of sleepers.

Mix design shall be revised, if minimum strength of 40 steam cured cubes is less than 50 N/mm<sup>2</sup> following the above mentioned stipulations on steam curing cycle. The steam curing cycle which is proposed to be adopted shall have prior approval of the inspecting official.

- 4.5.2 After de-tensioning & de-moulding, the sleepers shall be cured for a further period of not less than 14 days (as per mix design) by submerging in water tanks. Water used for curing should conform to the quality prescribed for water to be used for concrete mix.
- 4.5.3 Each steam chamber in stress bench method shall be attached with a separate digital thermal sensor, temperature shall be recorded continuously and record shall be maintained.

#### 4.6 **Supervision**

4.6.1 Suitably qualified persons as per Schedule of Technical Requirements (STR) shall be engaged by the manufacturer for supervising the following items at the works:

- (i) Testing of cement, cement mortar cubes, concrete cubes, concrete beams;
- (ii) Calibration of testing and measuring equipment and different gauges;
- (iii) Placing and stressing of prestressing wire;
- (iv) Batching, mixing, placement and compaction of concrete. Checking of the steam curing arrangement for its adequacy.
- (v) Demoulding of sleepers, water curing, stacking/ loading etc.
- (vi) Inserts shall be checked by suitable jigs before use by the manufacturer;
- (vii) Checking electrical resistance of sleepers.
- (viii) Inspection of individual sleepers and in assembled turnout and testing.

4.6.2 Supervisor so engaged shall maintain records as directed by the Inspecting Officer and shall present them for scrutiny when demanded.

- i) A site register shall be maintained in which inspecting officer shall record observations against which compliance will be recorded by the supervisor.
- ii) Suitable records of manufacture of sleepers as per Schedule of Technical Requirement shall be maintained in such a manner that it can be correlated at a later date to the sleeper laid in field.

#### 4.7 **Finish**

4.7.1 All sleepers shall be free from surface defects such as water retaining pockets, air holes or honey combed formations. The underside of the sleeper coming in contact with ballast shall be left rough but the unevenness shall not exceed 5mm. The ends of the prestressing wires shall be cut close to the surface of the sleeper and in no case shall project more than 3 mm from the concrete surface. Two coats of suitable ISI mark anti corrosive paint, approved by Inspecting Officer, shall be applied at the ends of the sleepers in the following manner:

- i) First coat of paint, sufficient thick to form impervious film of paint covering full surface of either ends of a sleeper shall be applied just after de-moulding from sleepers mould, and
- ii) Second coat after taking out the sleepers from submerged water curing tank in the above manner, ensuring that surface to be painted is completely dry and clean of dirt etc.

4.7.2 No touching up or finishing by cement mortar etc. shall be permitted on concrete sleeper, after it is demoulded, except as provided in clause 4.7.3.

4.7.3 Such sleepers which are not found acceptable due to surface defects, shall be accepted up to a ceiling of 1% of the supplies made any time during the currency of the contract provided such sleepers are adequately treated with epoxy compounds to the satisfaction of the Inspecting Officer. These sleepers shall be marked as shown in Drawing No.RDSO/T-4216/Alt.1 (marking on prestressed concrete sleepers for turnouts) before dispatch. The rectified sleepers shall be paid for at the rates fixed by the Purchaser.

#### 4.8 **Stacking**

4.8.1 After the sleepers have been cured in terms of clause 4.5.2 and checked both dimensionally and visually they shall be stacked at convenient place set wise separately. The stacking of sleepers shall be done on leveled and consolidated ground, one over another for one set. Each layer shall be separated by wooden/concrete battens of 50mm x 50mm size of suitable lengths to avoid any damage.

4.9        **Lots**

4.9.1      All sleepers cast in one shift shall form one lot.

5.        **INSPECTION AND TESTING**

5.1        The manufacturer shall supply at his expense, all the sleepers required for tests and retests, samples of materials, labour, machine, tools, gauges, apparatus, forms of test reports etc. and any other item which may be necessary or required by the Inspecting Officer for carrying out any or all of the checks and tests mentioned in these specifications and shall render all reasonable assistance in conducting such checks and tests. All measuring and testing appliances shall be got checked and calibrated according to the schedule given in Annexure-I, through government approved agency or as directed by the Inspecting Officer. The calibration certificate shall be furnished to the Inspecting Officer. The cost of all such checks and calibrations shall be borne by the manufacturer.

The plant controlling Railway officer minimum JAG level have liberty to recalibrate the various gauges and testing equipments in the concrete sleeper plant or by engaging the external government approved agency who can bring their calibration equipments at the plant itself, whenever they consider necessary. The necessary arrangements will be facilitated by the manufactures and cost will be borne by the manufacturer.

5.2        Inspecting Officer and the Purchaser shall have free access at all reasonable times to the works in which the sleepers are manufactured. They shall be at liberty to inspect the manufacture of sleepers at any stage and to reject any material supplies not conforming to the terms of the specifications and to reject sleepers not manufactured according to approved manufacturing process. They shall be provided with necessary assistance for inspection by the manufacturer.

5.3        **Checks and tests**

5.3.1      In addition to the control checks exercised on the materials and manufacturing process specified above, the concrete and the finished sleepers shall be subjected to regular checks and tests, after 14 days submerged water curing as detailed in clause 5.3.1.1.

#### **5.3.1.1 Visual and Dimensional Check**

Every sleeper shall be visually inspected for surface finish. No sleeper shall have surface defects except as provided in para 4.7.3.

Sleeper dimensions to be checked are listed below:

- (i) Critical dimensions are toe gap, location of inserts and dowels, angularity of inserts in plan, slope inclination at rail seat and camber in sleeper.
- (ii) General dimensions are depth of sleeper, width of sleeper at top and bottom; length of sleeper, camber at rail seat, wind at rail seat and position of high tensile steel wires at ends.

The sketch at Annexure-IV shows the dimension checking arrangement. The dimensions, shown on the sleeper drawing, shall be checked by means of approved gauges, procured by the manufacturer. (Annexure-IV shows the gauge for measuring toe gap of rail seat).

a) For the first ten sets

All sleepers shall be checked visually and dimensionally.

b) For subsequent sets

All sleepers shall be checked hundred percent visually. At least 20% sleepers shall be checked for critical dimensions and 5% for other general dimensions, but 100% for dimensions of fixtures like inserts and dowels on the centre line of sleepers.

#### **5.3.1.2 All sleepers after having been checked as per clause 5.3.1.1 shall be laid on level platform and the dimensions of the assembled Turnouts shall be checked**

- a) each set for initial 10 sets or till stabilization of production
- b) one set for every 10 sets or part thereof after stabilization of production.

The set shall be accepted dimensionally only if it passes this test.



5.3.2 **Casting of cubes**

- 5.3.2.1 15 cm size cubes shall be cast on a vibrating table conforming to IS: 2514 from random samples spread over the entire lot, out of concrete used for casting sleepers for testing prior to transfer of prestress and at 15 days.

5.3.3 **Method of testing**

- 5.3.3.1 The cubes shall be surface dry at the time of testing. The rate of loading shall be about 400 KN/minute.

5.3.4 **Compressive strength of concrete at transfer (release) of prestress**

- 5.3.4.1 These cubes shall be steam cured along with sleepers in the same manner and tested for transfer of prestress to concrete (at least one cube for every steam chamber/3 for each long line but not less than a total of 3 in any case).

5.3.5 **Test for 15 days compressive strength of concrete**

- 5.3.5.1 These cubes shall not be steamed but shall be water cured for 14 days after de-moulding. Two number of samples per lot (one sample comprises of 3 cubes) shall be taken.

The samples should be spread over the entire period of concreting in a lot. Cubes of these samples shall be tested for 15 days compressive strength of concrete. The test result of a sample shall be the average of the strength of three cubes. Individual variation in cube strength in a sample should not be more than  $\pm 15\%$  of the average. If variation is more than  $\pm 15\%$ , the test results of the sample is invalid and the lot shall be rejected.

Further, if mean of two test results of two samples is  $< f_{ck}$  and / or minimum of the two test results of two samples is  $< f_{ck} - 5$  N/mm<sup>2</sup>, the lot shall also be rejected. Where,  $f_{ck}$  is characteristic strength of concrete i.e. 60 N/mm<sup>2</sup> for M60 grade of concrete.

Otherwise, the concrete is accepted for further testing of sleepers as per para 5.3.7.2.2.

5.3.6 **Test for 15 days modulus of rupture of concrete**

- 5.3.6.1 The test for 15 days modulus of rupture of concrete shall be carried out on concrete beams of 10 x 10 x 50 cm size as specified in IS:516. One specimen shall be tested daily for the

first ten sets and once a week thereafter. If any value falls below 5.5 N/sq.mm, the mix design shall be reviewed.

### 5.3.7 **Tests for static bending strength of sleepers**

#### 5.3.7.1 **Method of testing**

5.3.7.1.1 The tests shall be conducted in accordance with the arrangement shown in Annexure-I.

5.3.7.1.2 The sleepers shall be loaded gradually (30-40 kN/Min.) upto the specified load, which will be retained at this level for three minute for observing cracks, if any. For the purpose, a crack is defined as one which is barely visible to the naked eye and is at least 15mm long from the tension edge of the sleeper. However, if crack appears at a load smaller than the specified load, that value shall be recorded.

5.3.7.1.3 In case of 'Moment of Resistance' (MR) test, the sleeper shall be deemed to have passed the test if it sustains the loads specified in Annexure-I without cracking. While loading, load can be applied upto 5KN in excess of specified load.

5.3.7.1.4 In case of 'Moment of failure' (MF) test, the sleeper shall be deemed to have passed the test if it is able to take load beyond the specified test load. The initial cracking loads shall also be recorded for sleeper top and sleeper bottom for further statistical analysis of data during MF test.

5.3.7.1.5 Sleepers for test shall be selected randomly by the inspecting officer.

#### 5.3.7.2 **Acceptance tests**

##### 5.3.7.2.1 **Moment of Failure (MF) test (Sleeper bottom)**

For the first ten lots, one sleeper shall be tested from each lot. These sleepers shall be so selected as to cover the full range of length from different lots. After ten lots the scale of testing shall be reduced to one sleeper per ten lots.

##### 5.3.7.2.2 **Moment of Resistance (MR) test (Center top and center bottom of sleeper)**

Depending on 15<sup>th</sup> day test results of samples of the lot as mentioned in para 5.3.5, the scale of testing of sleepers for the lot shall be as follows (as explained in Table -1):

- i) Wherever mean of the two test results of two samples is  $\geq f_{ck} + 3 \text{ N/mm}^2$  or  $f_{ck} + 0.825 \times$  established standard deviation whichever is greater and minimum of the two test results of two samples is  $\geq f_{ck} - 3 \text{ N/mm}^2$  and the lot is not rejected as per the criteria given in para 5.3.5– one sleeper per lot
- ii) Wherever mean of two test results of two samples is  $< f_{ck} + 3 \text{ N/mm}^2$  or  $f_{ck} + 0.825 \times$  established standard deviation whichever is greater but  $\geq f_{ck}$  or minimum of the two test results is  $< f_{ck} - 3 \text{ N/mm}^2$  but  $\geq f_{ck} - 5 \text{ N/mm}^2$  or both and the lot is not rejected as per the criteria given in para 5.3.5 – two sleeper per lot
- iii) In case, mean of two test results of two samples is  $< f_{ck}$  and / or minimum of the two test results of two samples is  $< f_{ck} - 5 \text{ N/mm}^2$ , the lot shall be rejected and no testing for moment of resistance or moment of failure will be conducted.

**Table -1: Acceptance / Rejection Criteria of Concrete and No. of Sleepers for SBT Test per Lot**

| SN     | First condition   | Second Condition  | Conditions to be complied  | No. of sleeper per lot for test  |
|--------|---|---|--|--|
| Case 1 | If average of test results of two samples is $\geq f_{ck} + 3 \text{ N/mm}^2$<br>or<br>$\geq f_{ck} + 0.825 \times$ established standard deviation, $\text{N/mm}^2$ whichever is greater                            | If minimum of test results of two samples is $\geq f_{ck} - 3 \text{ N/mm}^2$                                   | Both conditions are to be fulfilled and the lot is not rejected as per the criteria given in para 5.3.5.             | Concrete is accepted and one sleeper will be tested for SBT from the lot.  |
| Case 2 | If average of test results of two samples is $< f_{ck} + 3 \text{ N/mm}^2$<br>or<br>$< f_{ck} + 0.825 \times$ established standard deviation, $\text{N/mm}^2$ whichever is greater but $\geq f_{ck} \text{ N/mm}^2$ | If minimum of test results of two samples is $< f_{ck} - 3 \text{ N/mm}^2$ but $\geq f_{ck} - 5 \text{ N/mm}^2$ | Any one of them or both conditions are fulfilled and the lot is not rejected as per the criteria given in para 5.3.5 | Concrete is accepted but two sleepers will be tested for SBT from the lot. |

|           |   |   |  |  |
|-----------|---|---|--|--|
| Case<br>3 | If average of test results of the two samples is $< f_{ck}$ N/mm <sup>2</sup> | If minimum of test results of two samples is $< f_{ck} - 5$ N/mm <sup>2</sup> | Any one of them or both condition are fulfilled. | Lot rejected without any further testing on sleepers of the lot. |
|-----------|---|---|--|--|

Note: Test procedure has been shown as a flow chart in Annexure-II

### 5.3.7.3 **Acceptance of 'lots'**

5.3.7.3.1 All sleepers tested in accordance with clause 5.3.7.1 should pass all the tests conducted for the lot to be accepted.

5.3.7.3.2 If any of the sleepers fail in any of the tests conducted, the lot shall be subjected to 'retest' as per clause 5.3.7.4.

### 5.3.7.4 **Retest**

#### 5.3.7.4.1 **MR (Moment of resistance)**

For every sleeper failed in case (i) of clause 5.3.7.2.2, two more sleepers from the lot shall be selected for testing as per clause 5.3.7.2.2

#### 5.3.7.4.2 **MF (Moment of failure)**

In case of failure of the sleeper in MF test, only one more sleeper from the lot shall be selected for testing.

5.3.7.4.3 For acceptance of the lot all the sleepers tested in 'retest' must pass all the tests conducted. However, sleepers failing in static bending tests shall be rejected and shall not be paid for.

5.3.7.4.4 The supply of sleepers tested and passed under case (ii) of clause 5.3.7.2.2 shall be restricted to 5% of the total quantity of sleepers passed at any stage.

### 5.3.8 **Measurement of electrical resistance**

5.3.8.1 All sleepers shall be tested as per Annexure-V for electrical resistance for their fitness for use in track circuited area.

5.4 For inspection of concrete sleepers, officials having competency certificate issued after due test by RDSO/Chief Track Engineer only shall be posted.

6. **STAMPING AND MARKING**

- 6.1 All the sleepers shall have legible permanently inscribed and painted markings on the top as per drawing No.RDSO/T-4216 Alt.1.
- 6.2 All sleepers pertaining to one set of turnout sleepers when assembled and passed in the manufacturer's premises shall be stamped showing the set number.
- 6.3 The accepted sleepers shall bear the passing marks of the Inspecting Officer in indelible paints. Sleepers which have been subjected to static bending strength test up to cracking and accepted, shall in addition be marked on the top in indelible paint with the letter 'T'. MF tested and accepted sleepers shall bear the marking 'MF' in paint with yellow bands at ends.
- 6.4 All sleepers of turnout fit for use in track circuited area shall bear the mark 'FTC' at the center of the sleeper.
- 6.5 Rejected sleepers shall be stacked separately by the manufacturer so as to avoid their mixing with the accepted sleepers. Such rejected sleepers shall be marked in the way specified in drawing No.RDSO/T-4216 Alt.1 or latest alteration. The rejected sleepers shall be permanently damaged so as to render them un-useable and a certification that all rejected sleepers of previous batches have been permanently damaged will be given by manufacturer before offering next batch for inspection. The same shall be verified and ensured by inspecting officials/ SSE's and AIE before issuing the IC.
- 6.6 All markings mentioned in para 6.1 to 6.3 shall be done with enamel paint of ISI mark and shall be such as to last for at least 3 years under normal weather conditions. Colour and quality of the paint used shall be got approved by the Inspecting Officer. All such markings shall be done by the manufacturer at his cost.

7. **LOADING AND DESPATCH**

- 7.1 One full set of turnout sleepers which has been passed and accepted by the Inspecting Officer shall be loaded for dispatch at a time.
- 7.2 The loading of the passed sleepers in wagon shall be done by the manufacturer at his cost as per the loading arrangement approved by the purchaser. The sleepers shall be properly

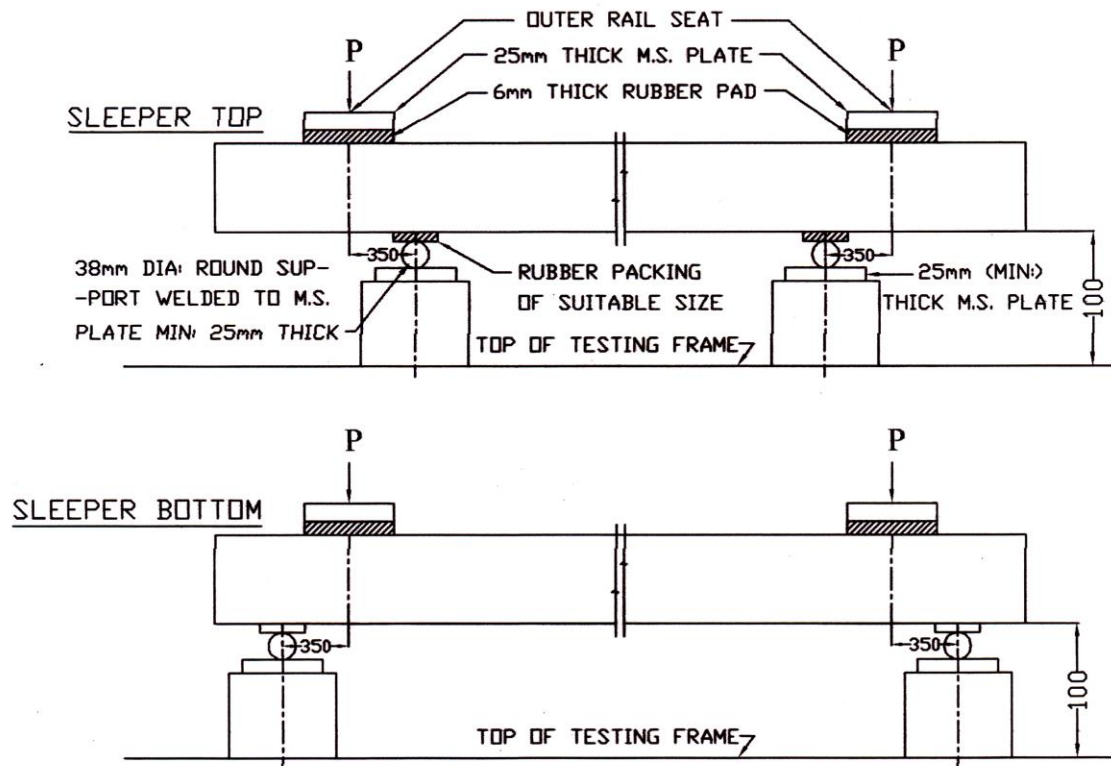
secured to avoid movement and displacement during transit. The manufacturer shall be responsible to replace, free of cost, all the sleepers which are found damaged in transit on account of defective loading.

8. **GUARANTEE**

- 8.1 The sleepers shall be guaranteed by the manufacturer for a period of five years from the date of its manufacture or for three years after they have been put in service in track whichever is earlier. If during the guarantee period any sleepers are found to develop defects attributable to bad material and workmanship as established during investigation, leading to large scale withdrawal from service, the cost of sleepers and their replacement shall be borne by the manufacturer. The defective sleepers withdrawn from service can be taken over at site by the manufacturer for their disposal. The manufacturer shall make good the cost due within 60 days of advice of defects. The sleeper manufacturer will also be involved during inspection / investigation and his view will be considered by the Purchaser before taking decision. The decision of the purchaser shall be final and binding in this regard.

## ANNEXURE-I

### TESTING ARRANGEMENT FOR STATIC BENDING STRENGTH TEST FOR PRESTRESSED MONOBLOCK CONCRETE SLEEPER FOR B.G. & M.G. TURNOUTS.



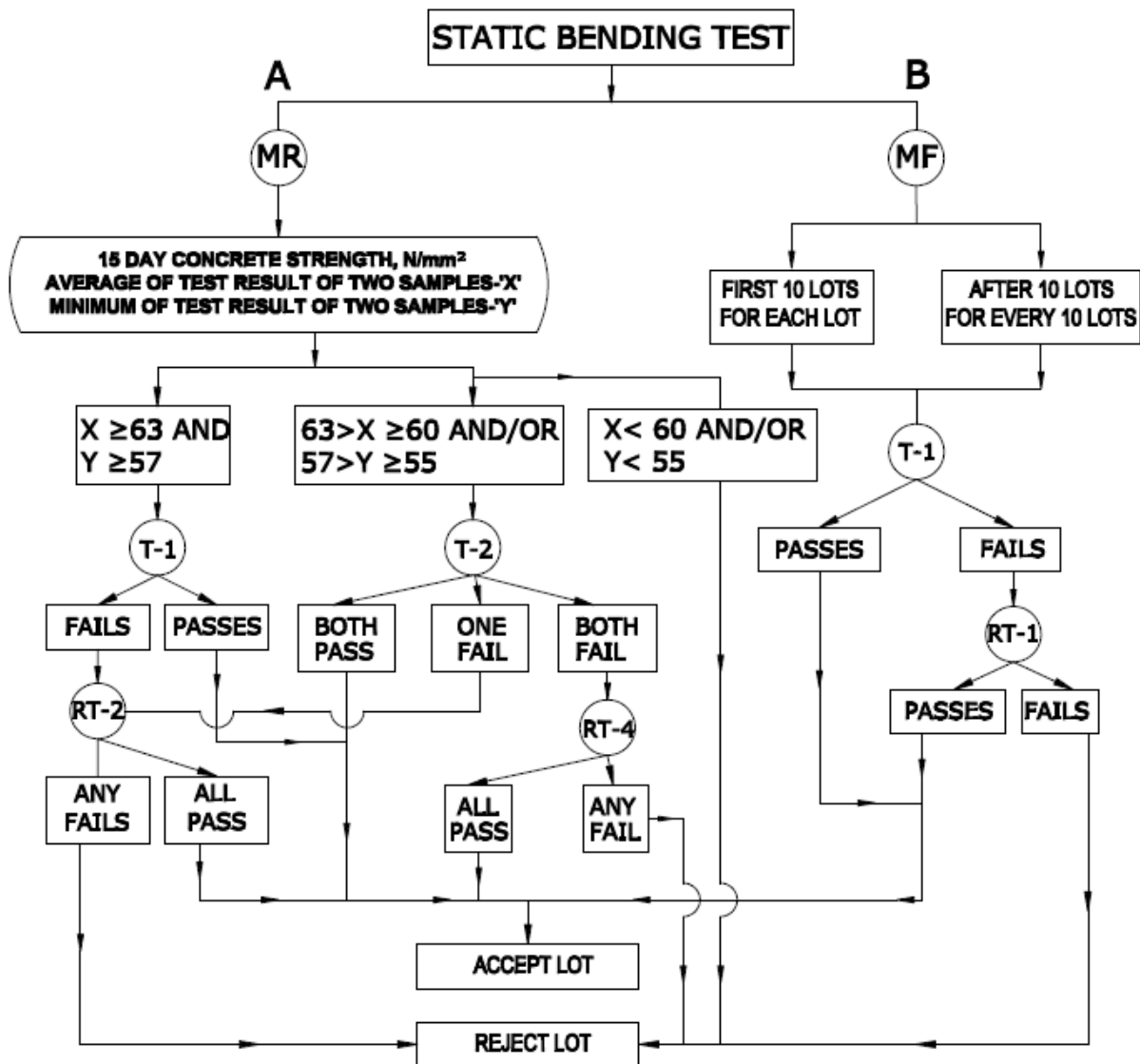
### TEST LOAD FOR ACCEPTANCE (PIN KN)

| GAUGE | CRACKING LOAD |                | FAILURE LOAD   | SLEEPER SECTIONS |
|-------|---------------|----------------|----------------|------------------|
|       | SLEEPER TOP   | SLEEPER BOTTOM | SLEEPER BOTTOM |                  |
| B.G.  | 65            | 85             | 160            | 240x260x210 DEEP |
| M.G.  | 35            | 55             | 110            | 200x240x180 DEEP |

#### NOTE:

1. All dimensions are in millimeters.
2. The load 'P' will be applied at centre line of outer Rail Seats.
3. At Rail seats 25 mm thick pressure distributing M.S. Plates of 150X240mm for BG rail and 130x200mm for MG shall be used.
4. Cracks shall not appear up to the load mentioned in column 2 & 3 when retained for three minute.
5. A coat of lime wash shall be applied on the sleeper surface before testing.
6. Sleeper with notches on top surface need not be tested, however they should not recast all together in one bench.

## FLOW CHART FOR TESTING OF TURN OUT SLEEPER



### REFERENCE:-

MR: MOMENT OF RESISTANCE TEST FOR TOP AND BOTTOM.

MF: MOMENT OF FAILURE TEST FOR BOTTOM.

T-2/RT-4: TEST/RETEST SLEEPER FROM THE SAME LOT.  
NO. OF SLEEPER TO BE TESTED.

PASS: SLEEPER PASSES RELEVANT TESTS SUCCESSFULLY.

FAIL: SLEEPER FAIL ANY OF THE RELEVANT TEST.

### NOT:-

1. WHEN DUE, MF TEST SHALL BE CONDUCTED ON THE FIRST SLEEPER SELECTED FOR TESTING UNDER MR.

2. WHENEVER MF IS DONE, PASSING THIS TEST IS A PREREQUISITE FOR ACCEPTANCE OF THAT LOT UNDER 'A' OF FLOW CHART.



**SCHEDULE FOR CALIBRATION OF VARIOUS GAUGES AND TESTING EQUIPMENTS IN THE CONCRETE SLEEPER PLANT**

| <b>S.No.</b> | <b>Equipment</b>   | <b>Frequency</b>   |
|--------------|--|--|
| 1            | 15 cm concrete cube testing machine (2000 KN capacity)               | Once in 3 months   |
| 2            | Cement mortar cube testing machine (500 KN capacity)                 | Once in 6 months   |
| 3            | Sleeper Static Bend Test Machine (1000 KN capacity)                  | Once in 3 months or after testing 250 sleepers, whichever is earlier.                      |
| 4            | Pre tensioning Jacks (1000 KN capacity)                              | Once a month or after casting 5000 sleepers whichever is earlier.                          |
| 5            | Pre-tensioning load cell   | Once a month or after casting 5000 sleepers whichever is earlier.                          |
| 6            | Concrete Beam Testing Machine (100 KN capacity)                      | Once in 6 months   |
| 7            | Aggregate weight batcher   | Once every week or after casting 2000 sleepers, whichever is earlier.                      |
| 8            | Cement weighing equipment  | Once every week or after casting 2000 sleepers, whichever is earlier.                      |
| 9            | Water Meter  | Once every week or after casting 2000 sleepers, whichever is earlier.                      |
| 10           | Admixture dispenser  | Once every week or after casting 2000 sleepers, whichever is earlier.                      |
| 11           | Master gauges for checking correctness of dimension measuring gauges | Once in 6 months   |
| 12           | Dimension checking gauges  | Once every 15 days or after inspecting 5000 sleepers, whichever is earlier.                |
| 13           | Proving rings (2000 KN, 500 KN, 1000 KN and 100 KN capacity)         | Once in 24 months or within the validity period of last calibration, whichever is earlier. |
| 14           | Weights & Measures   | By Weights & Measures Department as per extant rules.                                      |
| 15           | Tachometer   | Once a year  |

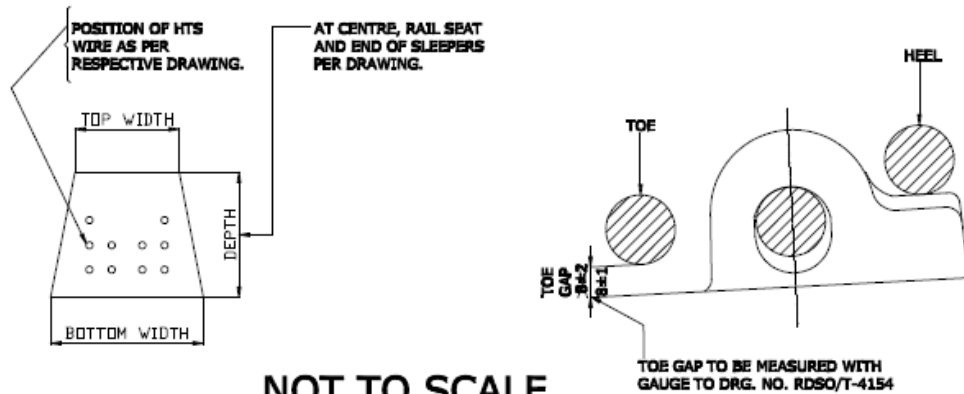
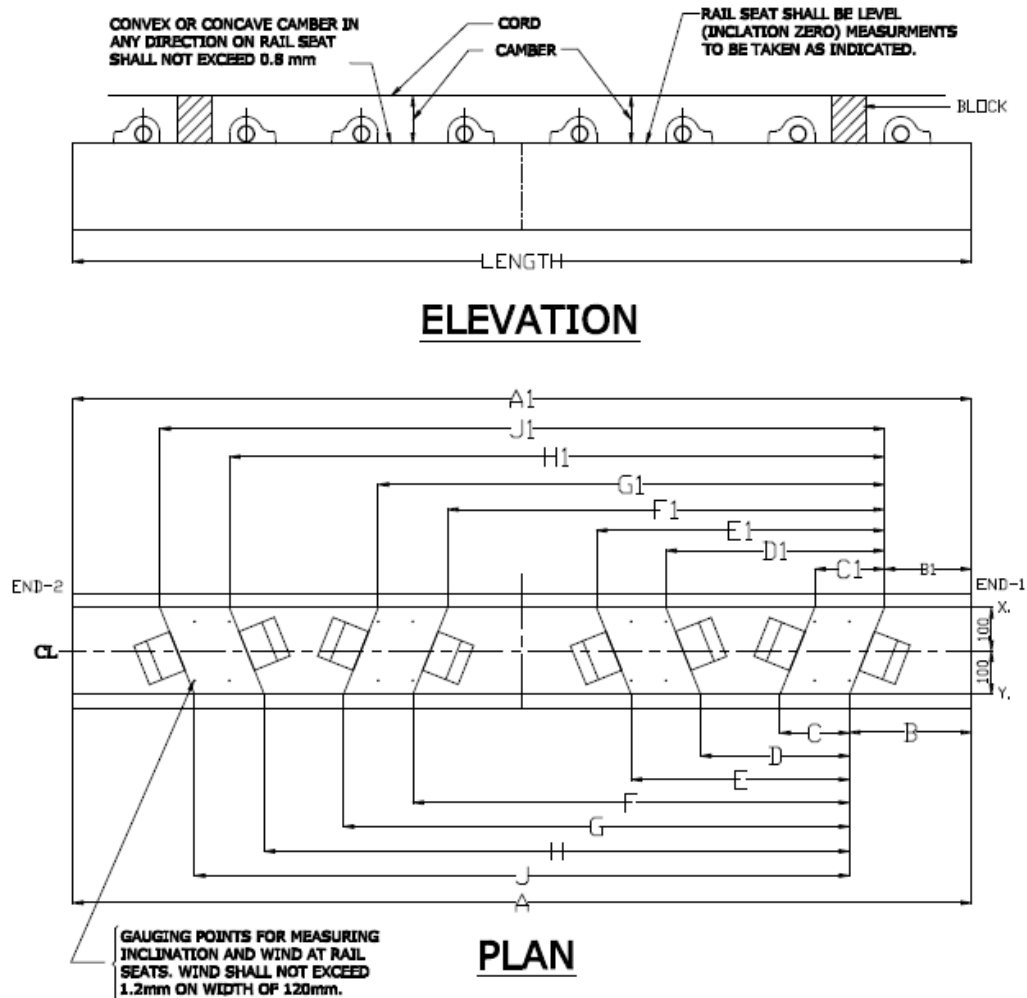
**Note:**

1. The items referred at S.No.1 to 6 above should be calibrated by proving rings in the sleeper plant itself.
2. The items referred at S.No.7, 8, 9 & 10 should be calibrated by dead weights.

3. The proving rings should be got calibrated from NABL approved laboratory / NCCBM/IITs/NITs.
4. The record of calibration of all the above equipments should be maintained in a manner that previous records can be easily connected.
5. The calibration can be done more frequently at the discretion of the Inspecting Official.

## ANNEXURE-IV

### DIMENSION CHECKING ON PSC SLEEPER



## ANNEXURE-V

### PROCEDURE FOR CHECKING FITNESS OF CONCRETE SLEEPERS ON TRACK CIRCUITED STRENGTH (AT THE TIME OF INSPECTION IN THE CONCRETE SLEEPER MANUFACTURER'S PREMISES)

1. All the sleepers shall be tested.
2. The sleeper shall be checked for electrical resistance at 230 volts AC supply. The circuitry to be followed will be shown in sketch at Annexure-V/A.
3. The 230 volts AC supply will be passed through a not less than 300 W test lamp in series with the pairs of inserts being tested. For the sake of comparison, another comparator bulb of the same wattage directly connected to the 230 volts AC supply will be fitted along side.
4. Since the testing is being done at a higher voltage, removal of the rust layer by grinding shall not be necessary.
5. For checking resistance against 4 rail seats, the resistance will be checked for 6 sets (combinations) across different rail seats as shown below :

|       |    |    |
|-------|----|----|
| Set 1 | M1 | T1 |
| Set 2 | M1 | M2 |
| Set 3 | M1 | T2 |
| Set 4 | T1 | M2 |
| Set 5 | T1 | T2 |
| Set 6 | M2 | T2 |

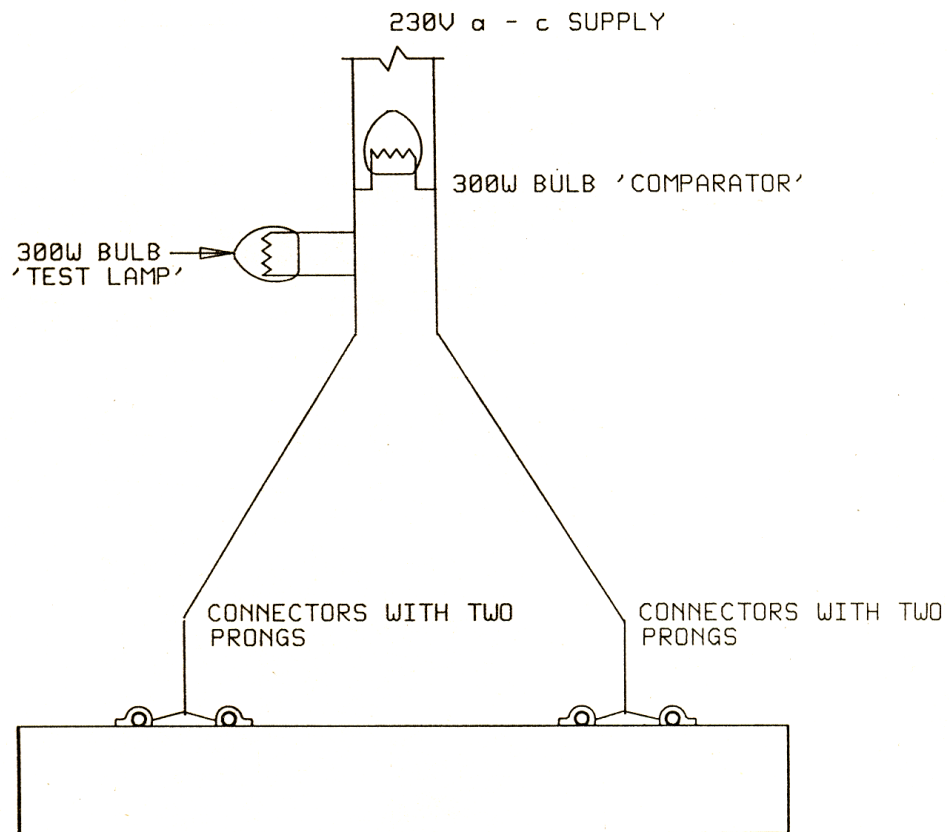
Where M1 and M2 are the rail seats for main line and T1 and T2 are the rail seats for turnout track formed by pair of inserts. Where the number of rail seats are less than four, the number of sets will accordingly get reduced. Annexure-V/A shows the testing arrangement.

6. If the test lamp emits light dimmer than the comparator lamp in the sleeper, the sleeper shall be accepted and marked 'FTC' (Fit for Track circuit). If it emits light with the same brightness as the comparator lamp, the sleeper will be rejected and marked 'NFTC' (Not fit for track circuit). In case the test lamp does not emit light at all, it indicates that the circuitry is defective and should be rechecked.

7. In the event of doubts regarding comparison of brightness, such sleepers will not be marked. They will be retested with 1.5 V Avometer and marked for fitness, if found fit with 200 ohms resistance.
8. The 'NFTC' marked sleepers should be stacked separately. The FTC/NFTC marking shall be done on top of sleepers in middle portion, as shown on Drawing No.RDSO/T-4216 Alt.1 or latest alteration.
9. As the testing is done at higher voltage, all precautions such as use of gloves in the hands, insulated boots and insulated chairs for operator and other necessary precautions shall be taken for the safety purpose.

ANNEXURE - V (CONTD.)

ELECTRICAL CIRCUIT FOR TESTING  
CONCRETE SLEEPER IN PLANT



- NOTE: 1. THE CONNECTORS SHALL HAVE TWO PRONGS EACH  
SO THAT BOTH INSERTS AT A RAILSEAT ARE  
TESTED AT A TIME.  
2. NECESSARY PRECAUTIONS FOR WORKERS SAFETY  
SHALL BE TAKEN.

**ANNEXURE-VI**

**LIST OF IRS & IS CODES REFERRED TO**  
 (Up-to-date version of Codes/Specifications with latest  
 amendments/correction slips shall be followed)

| <b>S.N<br/>o.</b> | <b>IRS/IS No. &amp; Year</b>                         | <b>Description</b>  |
|-------------------|--|---|
| 1                 | IS:269-2015  | Ordinary Portland Cement- Specification (Sixth Revision)  |
| 2                 | IS:1343 – 2012<br>(Reaffirmed-2017)                  | Prestressed Concrete-Code of Practice (Second revision)   |
| 3                 | IS:383 - 2016  | Coarse and fine aggregates for concrete-specification (third Revision)  |
| 4                 | IS:456-2000<br>(Reaffirmed-2016)                     | Plain and reinforced concrete- code for practice (Fourth Revision)  |
| 5                 | IS:516 – 1959<br>(Reaffirmed-2018)                   | Method of test for strength of concrete   |
| 6                 | IS:650 – 1991<br>(Reaffirmed-2018)                   | Standard sand for testing of cement (Second Revision)   |
| 7                 | IS:1785 Pt.I - 1983<br>(Reaffirmed-2018)             | Specification for plain hard drawn steel wire for prestressed concrete Part.I Cold drawn stress relieved wire (Second Revision) |
| 8                 | IS: 2386 - 1963<br>Pt. I – VIII<br>(Reaffirmed-2016) | Methods of tests for aggregate for concrete   |
| 9                 | IS:2430 –1986<br>(Reaffirmed-2019)                   | Methods for sampling of aggregate for concrete(First Revision)  |
| 10                | IS:2514 – 1963<br>(Reaffirmed-2017)                  | Specification for concrete vibrating table  |
| 11                | IS:2770 (Pt.1)-1967<br>(Reaffirmed-2017)             | Methods of testing bond in reinforced concrete Part 1: Pull-out test  |
| 12                | IS:3536 - 2016                                       | Ready mix paint, Brushing, Wood primer-Specification (second revision)  |
| 13                | IS:4031 –(Part-1)-<br>1996 (Reaffirmed-<br>2019)     | Methods of physical tests for hydraulic cement Part-1 Determination of fineness by dry sieving (Second Revision)                |
| 14                | IS:4031 (Part 2) -<br>1999<br>(Reaffirmed-2019)      | Part-2 Determination of fineness by specific surface by blaine air permeability method (First Revision)                         |
| 15                | IS:4031(Part 3) -<br>1988<br>(Reaffirmed-2019)       | Part-3 Determination of soundness (First Revision)  |
| 16                | IS:4031 (Part 4) -<br>1988<br>(Reaffirmed-2019)      | Part-4 Determination of consistency of standard cement paste (First Revision)   |
| 17                | IS:4031(Part 5) -                                    | Part-5 Determination of initial and final setting   |

|    |   |   |
|----|---|---|
|    | 1988 (Reaffirmed-2019)                    | times (First Revision)  |
| 18 | IS:4031 (Part 6) – 1988 (Reaffirmed-2019) | Part-6 Determination of compressive strength of hydraulic cement (other than masonry cement) (First Revision) |
| 19 | IS:4031(Part 14) - 1989 (Reaffirmed-2019) | Part-14 Determination of false set  |
| 20 | IS:4032 – 1985 (Reaffirmed-2019)          | Methods of chemical analysis of hydraulic cement  |
| 21 | IS:6006 - 2014 (Reaffirmed-2019)          | Uncoated stress relieved strand for pre-stressed concrete-Specification (Second Revision)                     |
| 22 | IS:9103 – 1999 (Reaffirmed-2018)          | Specification for concrete Admixture  |
| 23 | IS:10262 –2019                            | Concrete Mix Proportioning – Guidelines (Second Revision)   |
| 24 | IRS:T-46                                  | Specification for Spheroidal Graphite Cast Iron inserts   |
| 25 | Schedule of Technical Requirement (STR)   | Schedule of Technical Requirement for manufacture of PSC Sleepers as applicable from time to time.            |